Indian J. Agron. **41** (1) : 84–87 (March 1996)

Effect of phosphorus and potassium on greengram (*Phaseolus radiatus*)

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Received: August 1994

ABSTRACT

A field experiment was conducted during 1988 and 1989 at Kanpur, to study the effect of phosphorus and potassium on greengram (*Phaseolus radiatus* L.). Both P and K affected the seed yield and physiological parameters significantly. Phosphorus @ 60 kg/ha and K @ 20 kg/ha were found optimum. Seed yield showed positive correlation with leaf area, dry matter/plant, relative moisture content in leaves, number of branches, number of pods, seed yield/plant, 1,000-seed weight and harvest index.

Greengram (*Phaseolus radiatus* L.) is commonly grown in summer and rainy seasons in northern India. One of the important factors responsible for its low yield is no or inadequate use of plant nutrients, particularly phosphorus and potassium. A significant response of applied P has been reported by Pawar and Singh (1981) and that of potassium by Duke *et al.* (1980), in this crop. However, the study on the combined effect of phosphorus and potassium simultaneously has not largely been studied particularly in the Central Zone of this state. The present experiment was therefore planned to study the effect of varying levels of phosphorus and potassium on yield and agro-physiological parameters of greengram in sandy-loam soil of central Uttar Pradesh.

MATERIALS AND METHODS

The investigation was carried out at experimental research farm of Chandra Shekhar Azad University of Agriculture and Technology, Kanpur, for rainy season of 1988 and 1989 in a sandy-loam soil. It had 0.042% total nitrogen, 0.063% available P_2O_5 and 0.025% available K_2O, with 8.0 pH. The study was carried out in randomized block design. Treatments consisted of 3 levels of phosphorus (0, 30 and 60 kg/ha) and of potassium (0, 20 and 40 kg/ha), thus forming 9 treatments replicated 4 times. Single superphosphate and muriate of potash were the source of phosphorus and potash respectively in both the years. Full amount of P and K according to treatments was applied at planting below the seed. Nitrogen @ 15 kg/ha was also applied basal at planting below the seed. Cultivar 'T 44' of greengram was planted on 30 July and 19 July in first and second season respectively, whereas the final picking of pods was done on 12 October and 6 October in respective years. Crop received total precipitation of 528.3 mm in the first and 391.4 mm in the second season of study. Other agronomical practices were performed as per recommendation of the crop treating the field homogenous in both the years.

RESULTS AND DISCUSSION

Effect of phosphorus on yield and yield attributes

Phosphorus influenced the number of branches/plant significantly only in the second year and phosphorus registered a significant response over the control. Doses of 30 and 60 kg P_2O_5/ha however did not differ to each other statistically. Number of pods/plant was also influenced significantly by phosphorus only in the second year. Doses of 30 and 60 kg P_2O_5/ha being at par to each other registered significantly higher number of pods/plant over the control. Seed yield/plant was influenced significantly only in the first year and again both the doses, i.e. 30 and 60 kg P_2O_5/ha being at par registered a significant response over the control. The 1,000-seed weight and harvest index were influenced by phosphorus significantly during both the years. Phosphorus @ 30 kg P_2O_5/ha proved as good as 60 kg P_2O_5/ha for yield-attributing characters. This may be attributed to the available phosphorus status of the soil, being moderately high in the present study. Seed yield of greengram was however increased significantly up to 60 kg P_2O_5/ha in the first year, whereas in the second year the response was restricted only up to 30 kg P_2O_5/ha. The increase in yield is in concurrence to the increase in yield attributes in the present study. The results confirm to the findings of Arya and Kalra (1988) on greengram.

Effect of potassium on yield and yield attributes

Significant effect of potassium was noticed on the number of branches/plant in the second year, seed yield/plant in the first year, 1,000-seed weight, harvest index and grain yield in both the years. The effect on number of pods/plant was not significant in

Table 1. Effect of phosphorus and potassium on yield and yield components of greengram

Treatment (kg/ha)	Branches/plant		Pods/plant		Seed yield/plant (g)		1,000-seed weight (g)		Harvest index (%)		Seed yield (q/ha)	
	1988	1989	1988	1989	1988	1989	1988	1989	1988	1989	1988	1989
Phosphorus												
0	5.3	7.0	17.3	16.0	2.82	3.49	26.79	26.20	56.97	53.22	6.45	6.13
30	6.3	9.0	18.3	19.0	3.66	3.98	29.17	28.69	64.56	57.22	7.76	7.52
60	6.3	9.3	18.8	19.0	3.69	4.08	29.53	29.01	65.03	57.70	8.21	7.72
CD (P = 0.05)	NS	0.78	NS	1.68	0.13	NS	0.61	0.66	2.01	0.48	0.29	0.33
Potassium												
0	5.6	7.7	17.5	17.0	3.09	3.42	27.36	27.04	59.73	54.57	7.02	6.72
20	6.6	9.3	19.6	19.0	3.72	4.08	29.19	28.34	63.39	56.70	7.89	7.28
40	5.8	8.3	18.3	18.0	3.59	4.07	28.94	28.50	63.45	56.87	7.52	7.37
CD (P = 0.05)	NS	0.78	NS	NS	0.13	NS	0.61	0.66	2.01	0.48	0.29	0.33

any season of study. Number of branches in the second year was increased significantly only up to 20 kg K_2O/ha and thereafter declined up to 40 kg K_2O/ha, which was at par with the control. Seed yield/plant also increased significantly with the increase of doses of potassium in both the years. Seed yield/plant was at par at 20 and 40 kg K_2O/ha. 1,000-seed weight was significantly increased by 20 kg K_2O/ha over the control and higher dose. In the second year the dose of 20 or 40 kg K_2O/ha being at par to each other were statistically superior to no potassium. Harvest index followed the similar trend in both the years. In the first year dose of 20 kg K_2O/ha gave significantly higher grain yield than the control or 40 kg K_2O/ha (7.89 q/ha), though the higher dose was statistically superior to the control, whereas in the second year though maximum yield (7.37 q/ha) was registered under 40 kg K_2O/ha, but this was at par with lower dose, i.e. 20 kg K_2O/ha; however, these 2 doses were significantly superior to no potassium. The restricted response of potassium in the present study on yield and yield attributes may be due to higher potassium status of the present soil (Table 1). The study however does prove the response of potassium on greengram. Response of K on gram up to 15 kg K_2O/ha has also been reported by Sharma *et al* (1978).

Phosphorus x potassium

The interaction of phosphorus and potassium was noticed significant effect in the seed yield in the first year only. Treatment of 60 kg P_2O_5/ha + 20 kg K_2O/ha registered the maximum seed yield (8.71 q/ha), followed by 8.36 q/ha seed yield recorded under 30 kg P_2O_5 + 20 kg K_2O/ha (Table 2). Thus 60 kg P_2O_5/ha + 20 kg K_2O can be safely applied to greengram. The interaction response of phosphorus and potassium has also been reported by Jana *et al.* (1990) in groundnut.

Effect of phosphorus on physiological attributes

The leaf area, dry matter/plant and relative water content in leaves were significantly influenced by phosphorus in both the years of study (Table 3). Maximum leaf area (472 and 453 cm^2) was recorded at 60 kg P_2O_5/ha in the first and second seasons respectively. Dry matter/plant was also increased by the increasing doses of phosphorus in both the years. The higher dose (60 kg P_2O_5/ha) was statistically superior to the control. In the second year the 2 doses being at par were statistically superior to the control. However, maximum 9.25 and 7.73 q/plant dry matter was produced by 60 kg P_2O_5/ha as maximum in both the seasons. This may be due to increased leaf area. The results confirm the findings of Kalita (1989) on greengram. Water content in leaves followed the trend of leaf area. Increased doses of phosphorus registered significantly higher water content in leaves in the both years.

Effect of K on physiological attributes

Potassium also influenced all the 3 physiological attributes significantly in both the years. The leaf area/plant increased significantly up to 20 kg K_2O/ha in the first year, while the increase was up to 40 kg K_2O/ha in the second year. The maximum dry mat-

Table 2. Interaction effect of phosphorus and potassium on seed yield (q/ha) (1988)

P_2O_5 (kg/ha)	K_2O (kg/ha)		
	0	20	40
0	6.11	6.59	6.66
30	6.85	8.36	7.71
60	8.10	8.71	8.18
CD (P = 0.05)	0.50		

Table 3. Effect of phosphorus and potassium on physiological attributes of mungbean

Treatment (kg/ha)	Leaf area/ plant (cm^2)		Dry matter/ plant (g)		Relative water content in leaves (%)	
	1988	1989	1988	1989	1988	1989
Phosphorus						
0	365	345	7.25	6.38	44.9	43.8
30	462	439	8.81	7.61	59.8	48.0
60	472	453	9.25	7.73	65.3	52.3
CD (P = 0.05)	5.03	5.46	1.57	0.14	1.2	1.3
Potassium						
0	363	349	7.21	6.34	54.0	45.8
20'	485	436	9.27	7.77	57.2	48.3
40	450	453	8.83	7.62	88.7	50.0
CD (P = 0.05)	5.03	5.46	1.57	0.14	1.2	1.3

ter/plant was registered under 20 kg K_2O/ha in both the years. Both the doses were also superior to control in both the years. Relative water content in leaves in both the years was influenced significantly with every increased dose of K_2O and the maximum water content in leaves, i.e. 88.7 and 50.0% was registered under 40 kg K_2O/ha in first and second season respectively.

Correlation

Correlation of all the above attributes with grain yield was worked out in terms of correlation coefficient (r). Physiological attributes like leaf area, dry-matter production/plant and relative water content in leaves were positively correlated with the grain yield in both the years (Table 4). The yield attributes like number of branches/plant, number of pods/plant, seed yield/plant, weight of 1,000-seed and harvest index were also found significantly correlated with grain yield in both the years.

Table 4. Correlation of agro-physiological attributes with grain yield

Character	Correlation coefficient (r)	
	1988	1989
Leaf area/plant	0.88**	0.93***
Dry-matter/plant	0.83**	0.88**
Relative water content in leaves	0.86**	0.91***
Branches/plant	0.85**	0.83**
No. of pods/plant	0.87**	0.91***
Seed yield/plant	0.89***	0.88**
1,000-seed weight	0.87**	0.98***
Harvest index	0.91***	0.98***

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